PROCEEDINGS OF SPIE

Oxide-based Materials and Devices XIV

David J. Rogers Ferechteh H. Teherani Editors

30 January – 2 February 2023 San Francisco, California, United States

Sponsored and Published by SPIE

Volume 12422

Proceedings of SPIE 0277-786X, V. 12422

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Oxide-based Materials and Devices XIV, edited by David J. Rogers, Ferechteh H. Teherani, Proc. of SPIE Vol. 12422, 124220Z © 2023 SPIE · 0277-786X · doi: 10.1117/12.2683761

Proc. of SPIE Vol. 12422 124220Z-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings: Author(s), "Title of Paper," in Oxide-based Materials and Devices XIV, edited by David J. Rogers, Ferechteh H. Teherani, Proc. of SPIE 12422, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X ISSN: 1996-756X (electronic)

ISBN: 9781510659490 ISBN: 9781510659506 (electronic)

Published by **SPIE** P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org Copyright © 2023 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

• The first five digits correspond to the SPIE volume number.

• The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

vii Conference Committee

FIRST-PRINCIPLES: THEORY AND MODELING OF GA2O3 I

12422 01 Diversity of split Ga vacancies in β -Ga₂O₃ (Invited Paper) [12422-68]

ROLE OF HYDROGEN IN GA2O3

12422 02 Persistent optical phenomena in oxide semiconductors (Invited Paper) [12422-9]

MODELLING AND THEORETICAL STUDIES OF OXIDES

12422 03 Polarons as a universal source of leakage currents in amorphous oxides: a multiscale modeling approach (Invited Paper) [12422-10]

GROWTH AND DOPING OF GA₂O₃

- 12422 04 Demonstration of thick phase-pure β-Ga₂O₃ on a c-plane sapphire substrate using MOCVD [12422-15]
- 12422 05 Polarization and orientation dependent optical properties in Czochralski-grown transition metal doped β-Ga₂O₃ [12422-17]

GA2O3 BASED APPLICATIONS

12422 06 Ultrawide bandgap Ga₂O₃ technologies: benefits of heterogenous integration (Invited Paper) [12422-18]

PHOTODETECTION USING OXIDES

12422 07 Dynamical properties and performances of β-Ga₂O₃ UVC photodetectors of extreme solar blindness (Invited Paper) [12422-22]

12422 08	Tuning of titanium dioxide surface energy levels by self-assembled monolayers for optoelectronic applications (Invited Paper) [12422-25]
12422 09	Novel P-type wide bandgap manganese oxide quantum dots for self-powered solar-blind deep UV devices (Invited Paper) [12422-65]
	OPTICAL STUDIES
12422 0A	Investigation of structural, optical, and photo responsive properties of erbium (Er) doped ZnO nanowire/p-Si heterojunction nanodevices for developing self-powered UV-detectors [12422-31]
12422 OB	Control of stoichiometry in garnet crystals presenting persistent luminescence (Invited Paper) [12422-32]
12422 OC	Electronic and optical properties of 3d-transition metals in β -Ga ₂ O ₃ (Invited Paper) [12422-74]
	SENSORS
12422 OD	Realization of prism-based surface plasmon resonance sensor for detection of methane gas [12422-37]
12422 OE	Experimental analysis of rGO coated eFBG sensor for the detection of harmful smokes [12422-38]
12422 OF	Optical gas sensing at extreme temperatures using perovskite oxides on single crystal fiber [12422-40]
12422 0G	Zinc anode-based electrochromic devices for dynamic light modulation [12422-41]
	MATERIAL GROWTH I
12422 OH	Toward both p- and n-doping of hexagonal boron nitride using sub-bandgap illumination (Invited Paper) [12422-42]
12422 01	Development of a novel rutile-type SnO ₂ -GeO ₂ -SiO ₂ alloy system (Invited Paper) [12422-43]
12422 OJ	Physical and electrical characterization of a silicon suboxide seed layer (Invited Paper) [12422-44]

MATERIAL GROWTH II

- 12422 0K High quality optical Indium Tin Oxide (ITO) layers deposited by Ion Beam Sputtering (IBS) [12422-49]
- 12422 0L Artificial intelligence process control: deep reinforcement learning for Ga₂O₃ wafer production (Invited Paper) [12422-79]

POSTERS SESSION

- 12422 0M Iodoethylammonium (IEA+)-based lead- and iodide- deficient halide perovskites (d-HPs) for solar cells [12422-52]
- 12422 0N Investigation of spin-transport properties of modeled VS₂ device in the framework of DFT-NEGF for spintronic application [12422-57]
- 12422 00 Upconverted persistent luminescence in β-NaGd_{0.8}Yb_{0.17}Er_{0.03}F₄ and Zn_{1.33}Ga_{1.335}Sn_{0.33}Cr_{0.005}O₄ associated nanoparticles [12422-59]
- 12422 OP H₂ gas sensing properties of a Pd/ZnO:Eu nanosensor [12422-60]
- 12422 0Q Graphene/TiO₂ composite films for efficient photocatalytic degradation of antibiotics in wastewaters [12422-61]
- 12422 0S Temperature induced conductivity reversal in ZnO thin films [12422-63]
- 12422 0T Predicting the response of lead selenide thin film photoconductor in circuits with a series load resistor [12422-24]

PROGRESS IN APPLIED OXIDES

- 12422 0U Potential of ZrO₂ and HfO₂ materials for nonlinear optical applications: first-principle study and experimental challenges (Invited Paper) [12422-64]
- 12422 0V High performance all-oxide thin film tunable capacitors on Si substrates for agile microwave applications (Invited Paper) [12422-70]

PLASMONICS USING ZNO AND VARIOUS OXIDES

12422 0W CdO plasmonics on GaAs: using localized and surface plasmon polaritons for mid-IR near-field amplification (Invited Paper) [12422-53]

DIGITAL POSTERS

- 12422 0X Investigation of optical responsivity of BiFeO₃-based photodetectors equipped with different electrode patterns [12422-23]
- 12422 0Y Fabrication and characterization of the surface acoustic wave (SAW) based hydrogen sensor [12422-36]

Conference Committee

Symposium Chairs

Sonia M. García-Blanco, Universiteit Twente (Netherlands)
Bernd Witzigmann, Friedrich-Alexander-Universität Erlangen-Nürnberg (Germany)

Symposium Co-chairs

Ulrich T. Schwarz, Technische Universität Chemnitz (Germany) Karin Hinzer, University of Ottawa (Canada)

Program Track Chairs

James G. Grote, Photonics Engineering Consultant (United States) Shibin Jiang, AdValue Photonics, Inc. (United States)

Conference Chairs

David J. Rogers, Nanovation (France) Ferechteh H. Teherani, Nanovation (France)

Conference Program Committee

Vitaliy S. Avrutin, Virginia Commonwealth University (United States) Philippe Bove, Nanovation (France) James Connolly, Université Paris-Saclay (France) Nicolas de France, Université de Lille (France) Jean-Jacques Delaunay, The University of Tokyo (Japan) Aleksandra B. Djurišic, The University of Hong Kong (Hong Kong, China) Adrián Hierro, University Politécnica de Madrid (Spain) Seref Kalem, Bahçesehir University (Turkey) David C. Look, Wright State University (United States) Luna Lu, Purdue University (United States) Bianchi Méndez Martín, Universitat Complutense de Madrid (Spain) Norbert H. Nickel, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH (Germany) **Ümit Özgür**, Virginia Commonwealth University (United States) Seong-Ju Park, Gwangju Institute of Science and Technology (Korea, Republic of) Manijeh Razeghi, Northwestern University (United States) **Vinod Eric Sandana**, Nanovation (France) Michael L. Schuette, Air Force Research Laboratory (United States)

Cuong Ton-That, University of Technology, Sydney (Australia) Chris G. Van de Walle, University of California, Santa Barbara (United States)

Bruno Viana, Institut de Recherche de Chimie Paris (France) Markus R. Wagner, Technische Universität Berlin (Germany) Magnus Willander, Linköping Universitet (Sweden) Hideki Yamamoto, NTT Basic Research Labs. (Japan)